Cooling channel RF cavity update
(gridded cavity)

R. Rimmer

LBNL

11/6/2000

- Last time showed 2D approximation,

- Need 3D to show transverse fields between tubes

- MAFIA mesh includes "Omega" shape, 10 x 12.5mm tubes per radius in two rows, horizontal and vertical

- Tubes meshed with octagon cross section (may be improved slightly with further manual meshing if necessary).

- Trapped mode in iris lower than 200 MHz - care needed if iris is smaller

- MAFIA solution for 3D grid shows transverse fields, will be used in cooling simulation to try to determine once and for all if scattering is acceptable

- Heating of tubes is non-uniform and on both sides

MAFIA

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
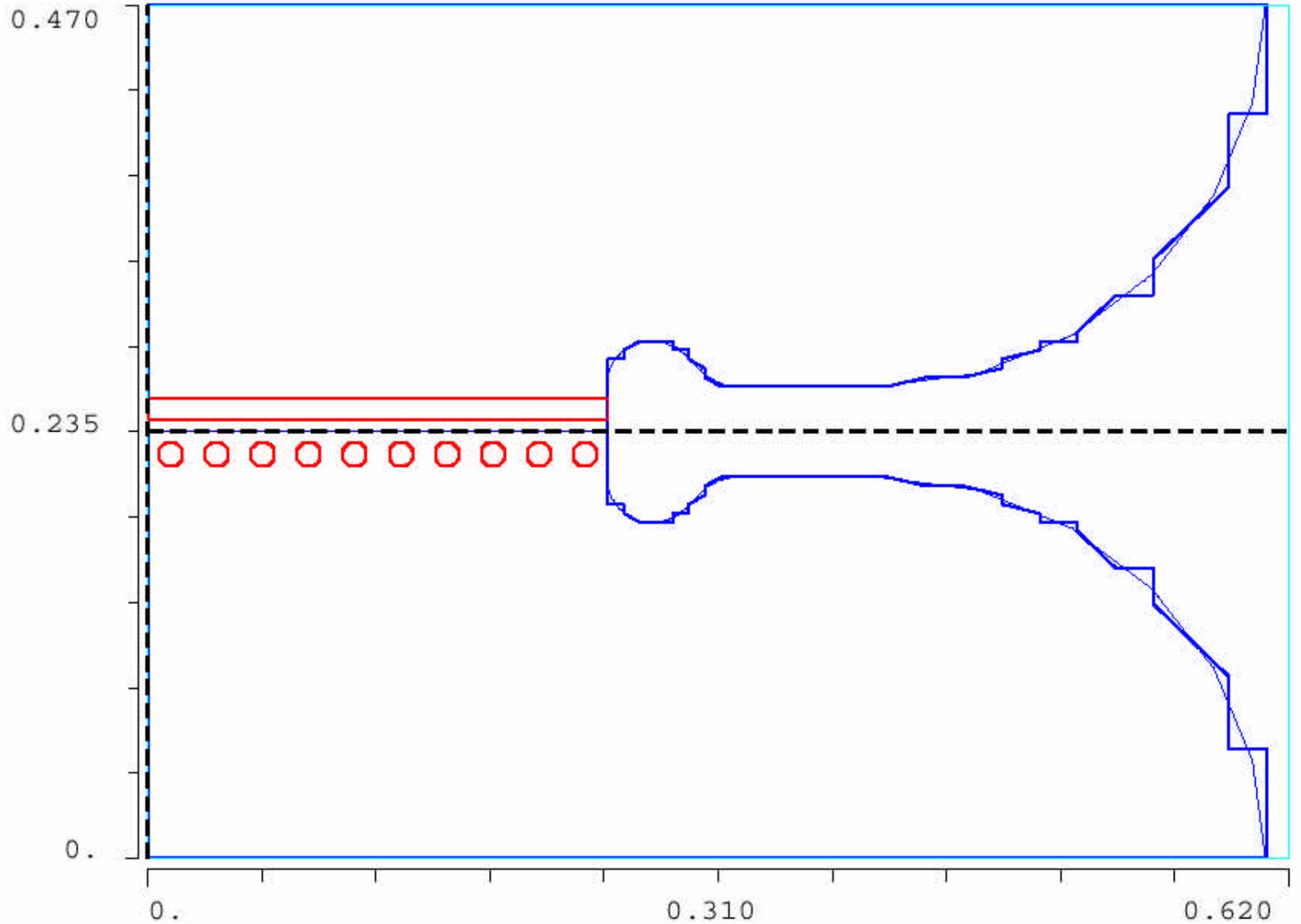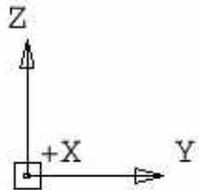CUT PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

OP-:4021

#2DPLOT

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
 [0.0093750,0.0093750]
Y[0.0000, 0.62000]
 [0.0000, 0.62000]
Z[0.0000, 0.47000]
 [0.0000, 0.47000]

MATERIALS: 1,2,3,

X-MESHLINE=   4
CUT AT X/M=   0.9375E-02
Y,Z-CUT   - - - -

Z

+X   Y

0.470

0.235

0.

0.   0.310   0.620

2D plot of cavity shape, material & tube arrays in iris

MAFIA

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
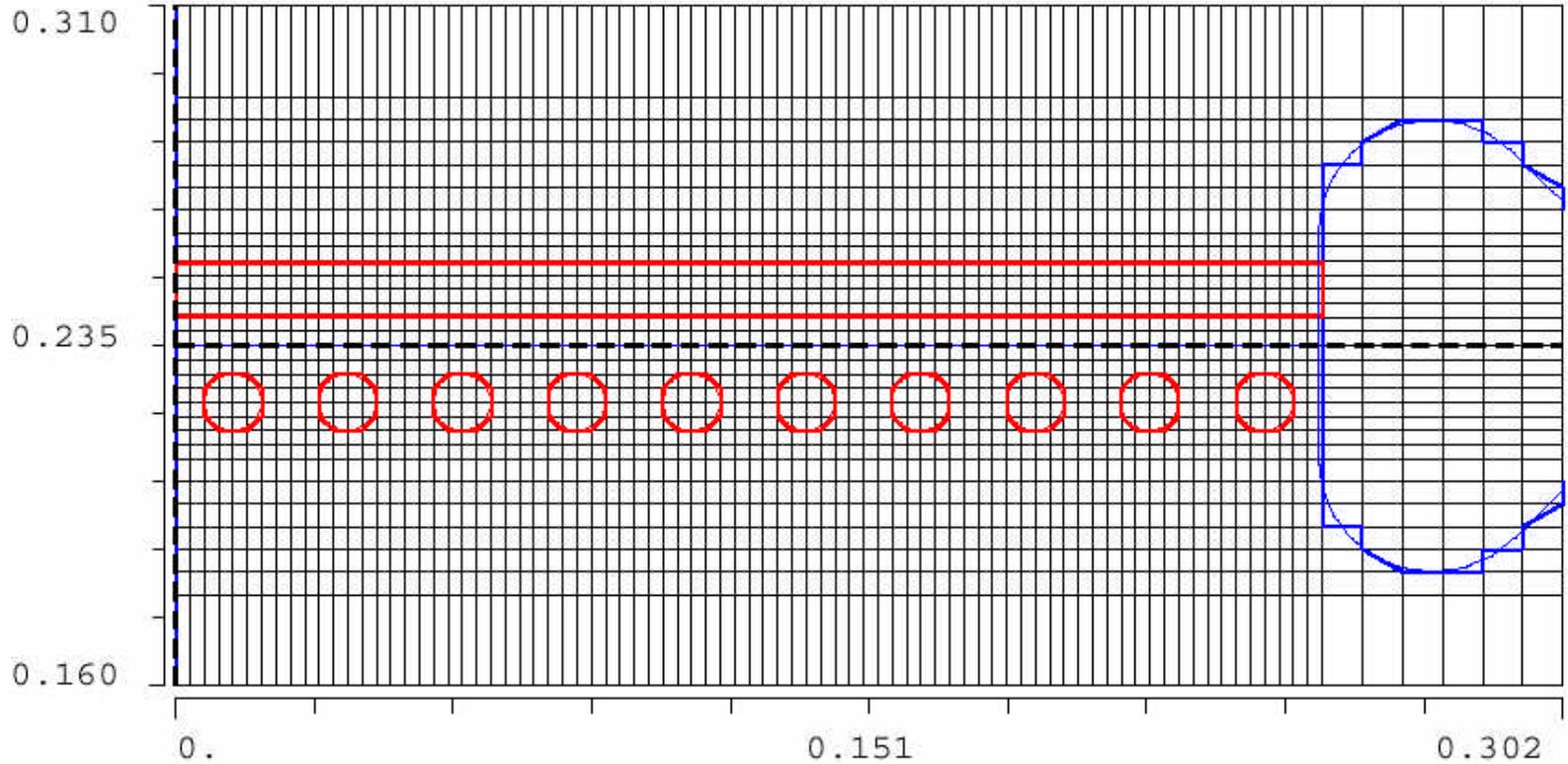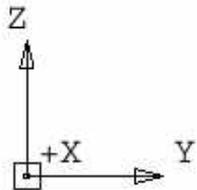201.5 MHZ
CUT PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

OP-:4021

#2DPLOT

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
 [0.0093750,0.0093750]
Y[0.0000, 0.62000]
 [0.0000, 0.30250]
Z[0.0000, 0.47000]
 [0.16000, 0.31000]

MATERIALS: 1,2,3,

X-MESHLINE=   4
CUT AT X/M=   0.9375E-02
Y,Z-CUT   - - - - -

0.310

0.235

0.160

0.   0.151   0.302

Z
+X   Y

2D close-up of tube arrays in iris + mesh

FRAME: 91   30/10/10 - 18:57:22   VERSION [V4.021]   ./TEST2.DRC
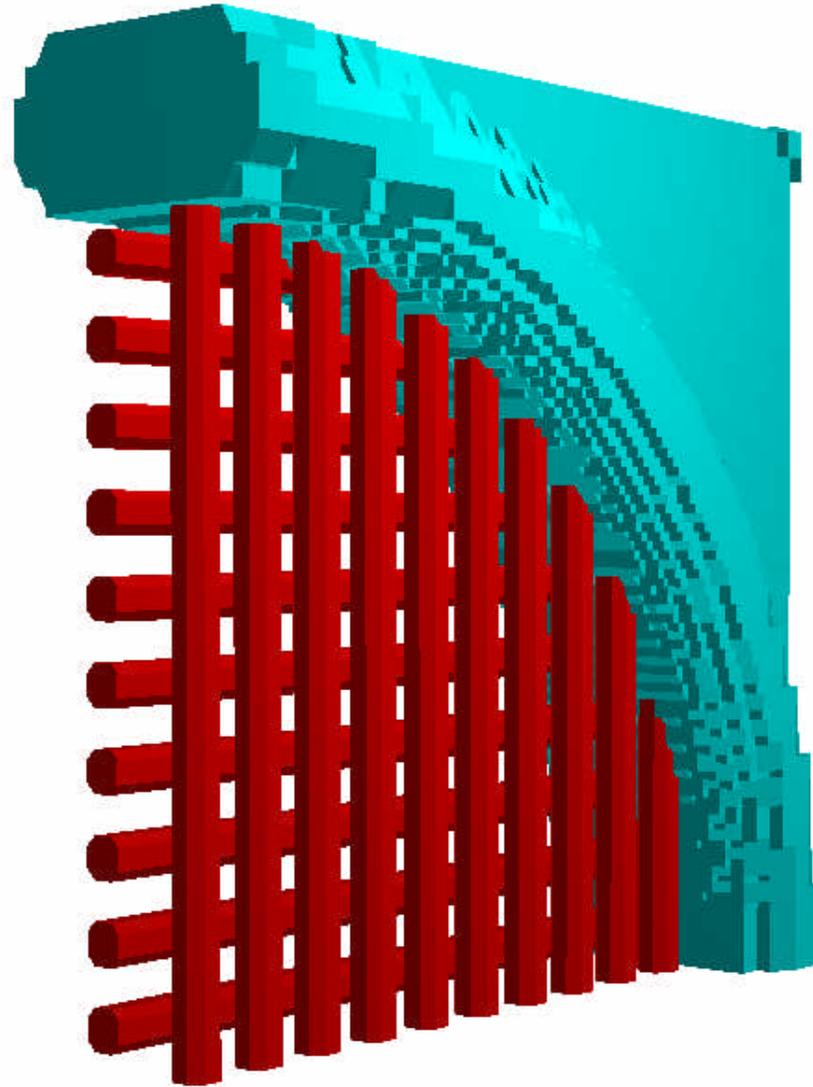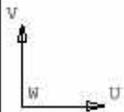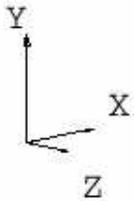
TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
3D PLOT OF THE MATERIAL DISTRIBUTION IN THE MESH

OP-:4021

#VOLUME

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000,   0.62000]
 [0.0000,   0.30250]
Y[0.0000,   0.62000]
 [0.0000,   0.30250]
Z[0.0000,   0.47000]
 [0.16000,   0.31000]

SYMBOL: UNDEFINE
TIME......:   2.0000
MATERIALS: 1,3,

Y
X
Z

V
W   U

3D close-up of tube arrays in iris

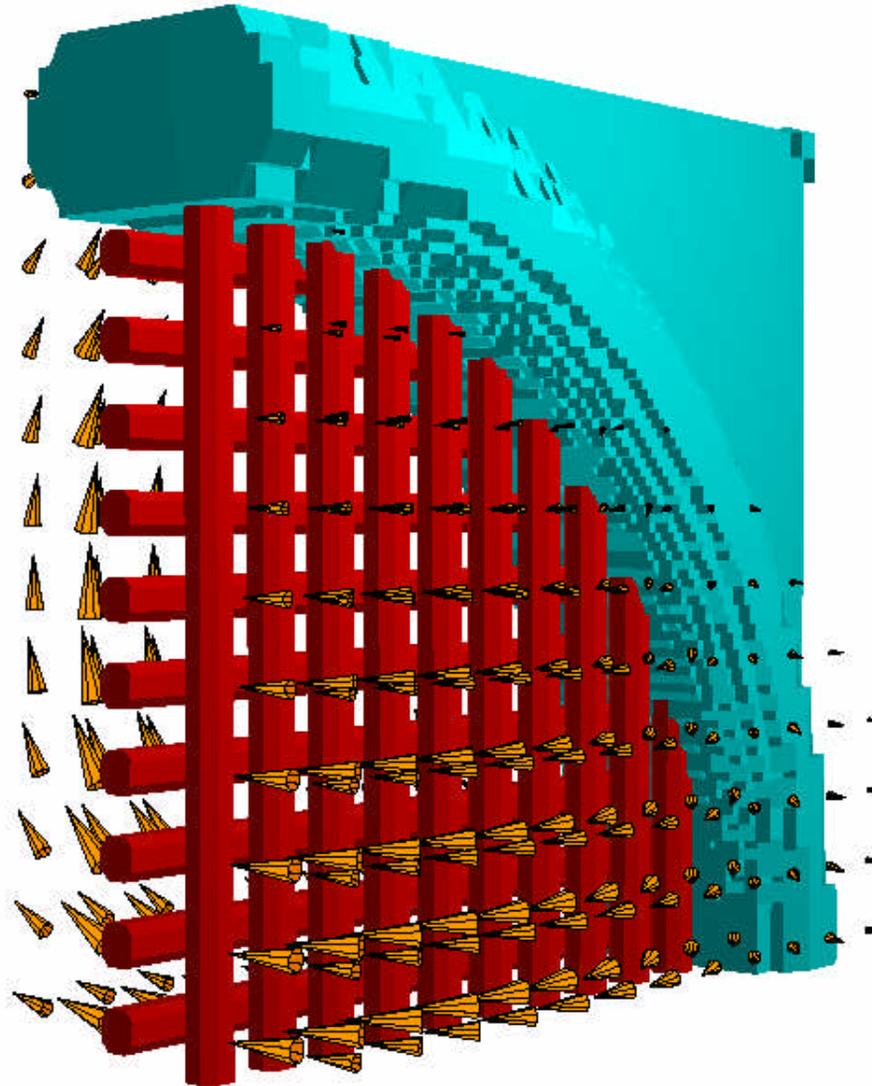FRAME: 95   30/10/10 - 18:57:22   VERSION[V4.021]   ./TEST2.DRC

FREQUENCY/HZ   1.3688548800000E+08   TEST MODEL COOLING CAVITY, 2 X HALF CELLS
MAXIMUM ERROR OF   CURLCURL-E   4.3635364621878E-02   QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
MEAN   ERROR OF   CURLCURL-E   1.3806176139042E-03   201.5 MHZ
MAXIMUM ERROR OF DIVERGENCE-D   7.2068871759257E-07   TIME HARMONIC ELECTRIC FIELD IN V/M

OP-:4021

#3DARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
 [0.0000, 0.30250]
Y[0.0000, 0.62000]
 [0.0000, 0.30250]
Z[0.0000, 0.47000]
 [0.16000, 0.31000]

SYMBOL: ERE_1
TIME......:   2.0000
MAX. ARROW.: 5.040E+00
INTERPOLATE=   1
LOGSCALE...=   0.
MATERIALS: 1,3,

Y
X
Z

V
W   U

3D close-up of trapped mode in iris (E-field)

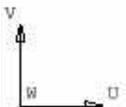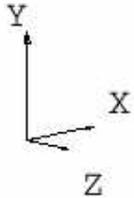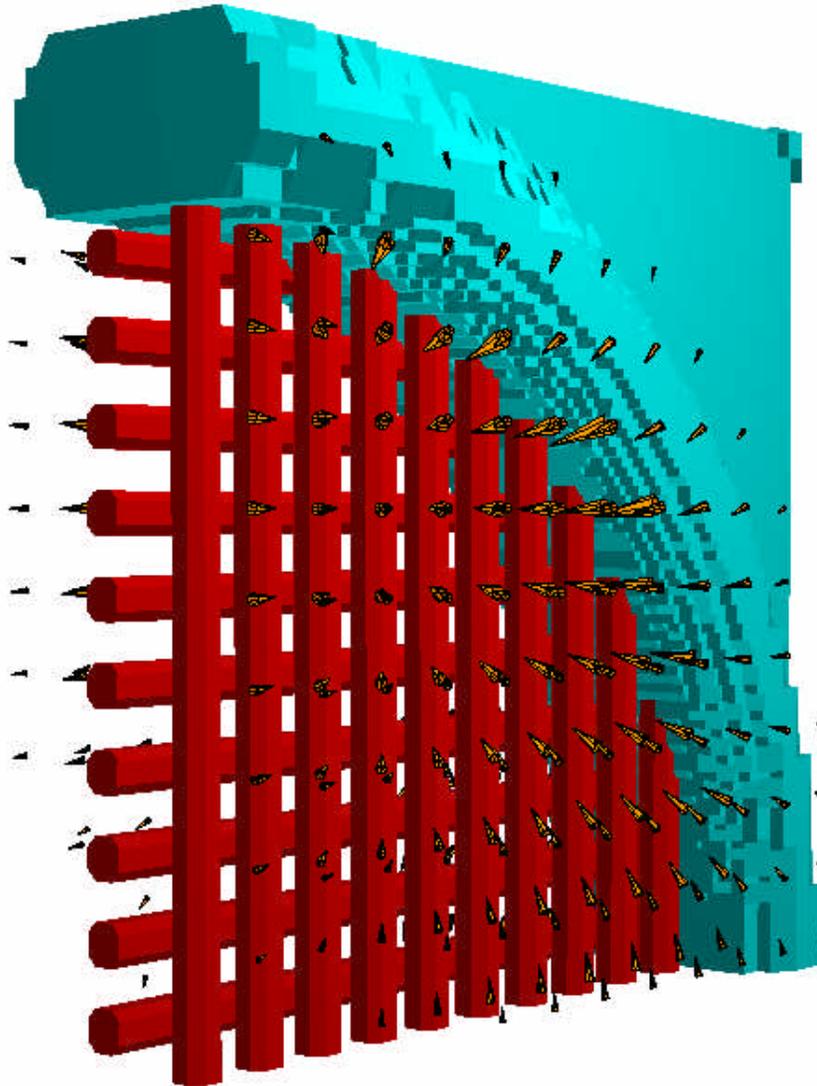FRAME: 97   30/10/10 - 18:57:22   VERSION [V4.021]   ./TEST2.DRC

FREQUENCY/HZ   1.3688548800000E+08   TEST MODEL COOLING CAVITY, 2 X HALF CELLS
MAXIMUM ERROR OF   CURLCURL-E   4.3635364621878E-02   QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
MEAN   ERROR OF   CURLCURL-E   1.3806176139042E-03   201.5 MHZ
MAXIMUM ERROR OF DIVERGENCE-D   7.2068871759257E-07   TIME HARMONIC MAGNETIC FLUX DENSITY IN VS/M**2

OP-:4021

#3DARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
 [0.0000, 0.30250]
Y[0.0000, 0.62000]
 [0.0000, 0.30250]
Z[0.0000, 0.47000]
 [0.16000, 0.31000]

SYMBOL: BRE_1

TIME......:   2.0000

MAX. ARROW.: 1.672E-08

INTERPOLATE=   1

LOGSCALE...=   0.

MATERIALS: 1,3,

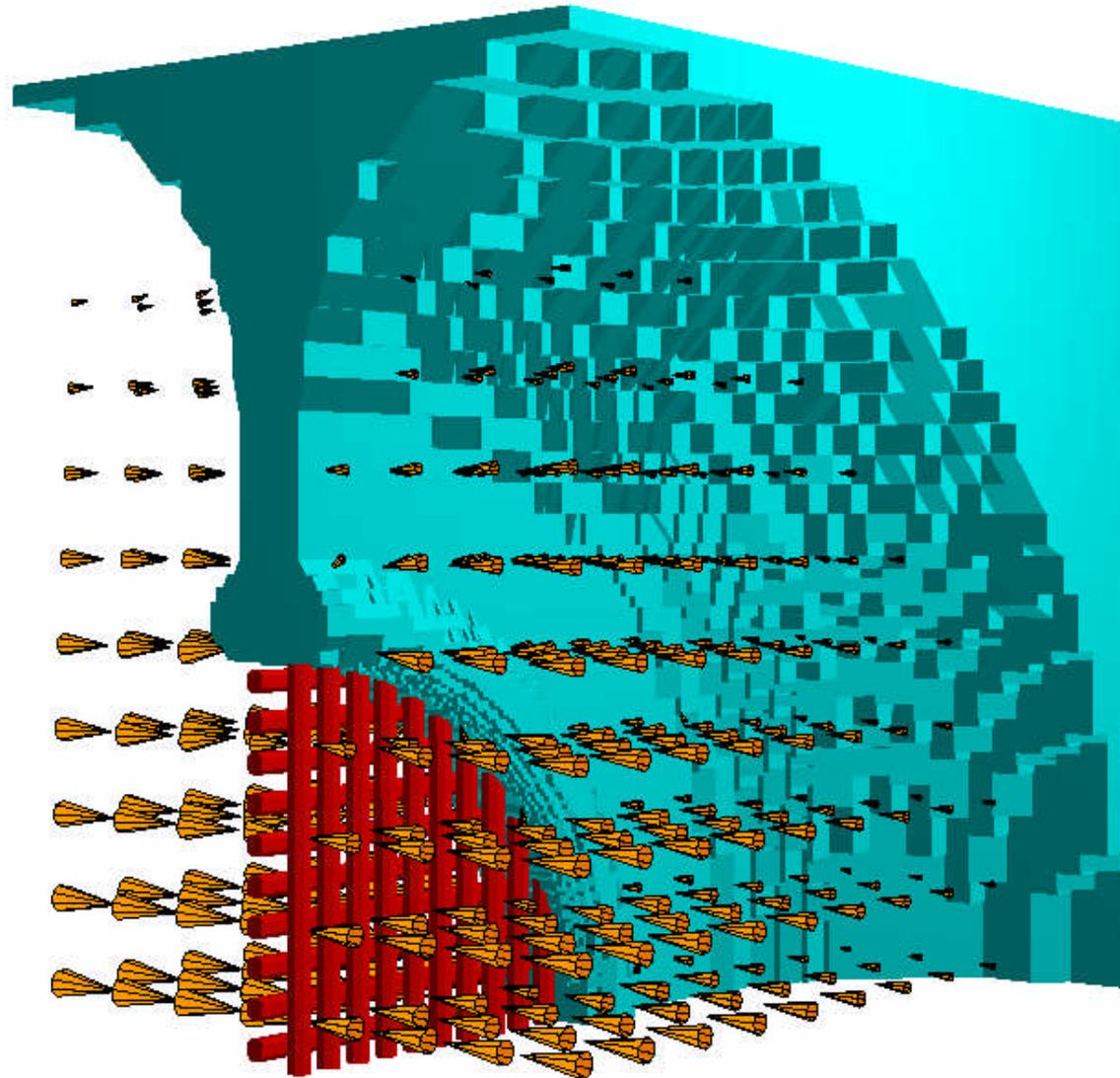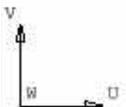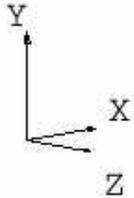3D close-up of trapped mode in iris (B-field)

MAFIA

FRAME: 74   30/10/10 - 18:57:22   VERSION[V4.021]   ./TEST2.DRC

+FREQUENCY/HZ   2.04065728000000E+08
+MAXIMUM ERROR OF   CURLCURL-E   2.2364331781864E-01
+MEAN   ERROR OF   CURLCURL-E   1.1217321269214E-02
+MAXIMUM ERROR OF DIVERGENCE-D   3.7391018122435E-04

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
TIME HARMONIC ELECTRIC FIELD IN V/M

OP-:4021

#3DARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000,   0.62000]
 [0.0000,   0.62000]
Y[0.0000,   0.62000]
 [0.0000,   0.62000]
Z[0.0000,   0.47000]
 [0.0000,   0.47000]

SYMBOL: ERE_2
TIME......:   2.0000
MAX. ARROW.: 5.509E+00
INTERPOLATE=   1
LOGSCALE...=   0.
MATERIALS: 1,3,

3D view of accelerating mode (E-field, 130° phase advance)

MAFIA

+FREQUENCY/HZ   2.04065728000000E+08
+MAXIMUM ERROR OF   CURLCURL-E   2.23643317818643E-01
+MEAN   ERROR OF   CURLCURL-E   1.12173212692143E-02
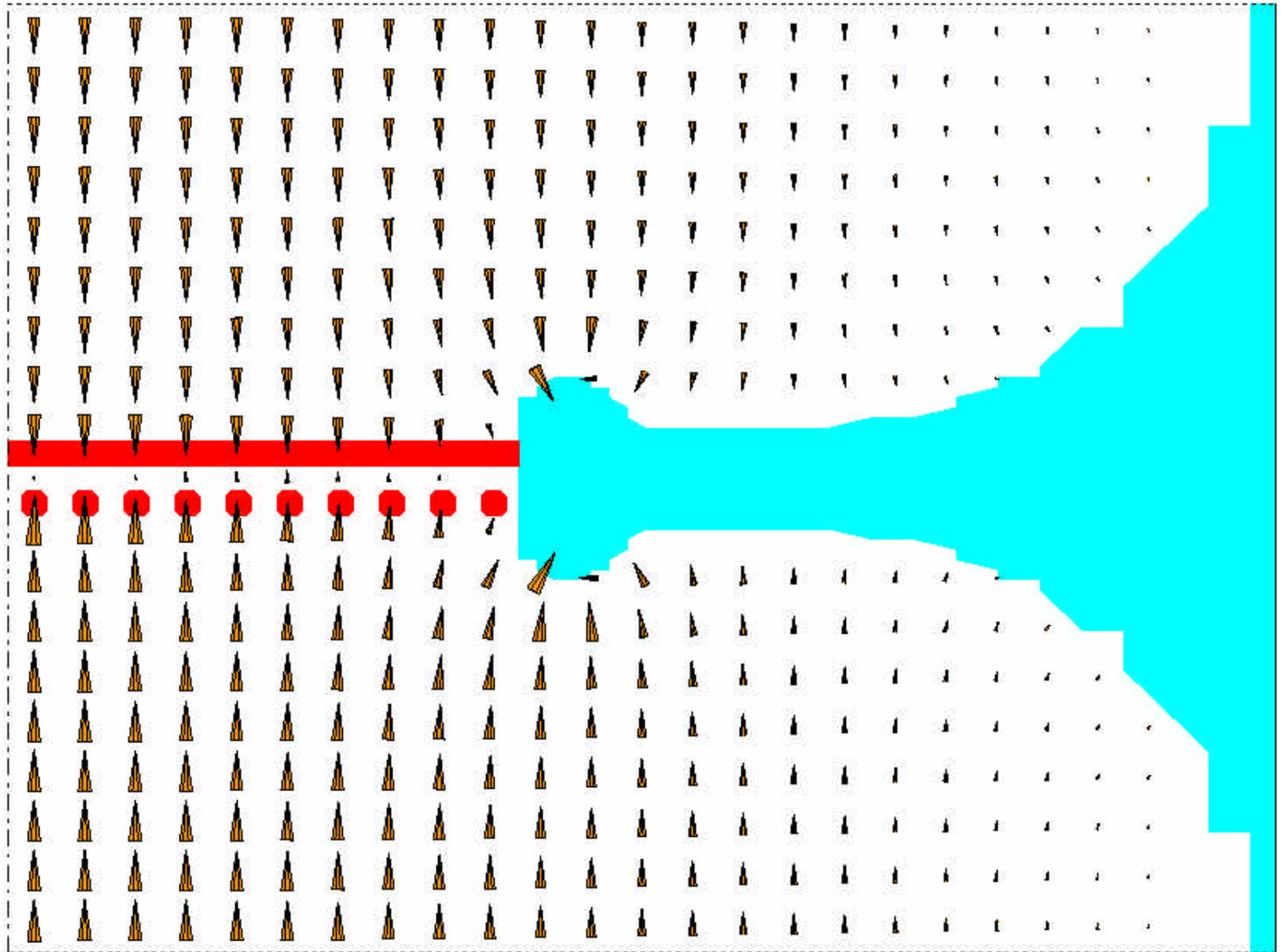+MAXIMUM ERROR OF DIVERGENCE-D   3.7391018122435E-04

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
TIME HARMONIC ELECTRIC FIELD IN V/M
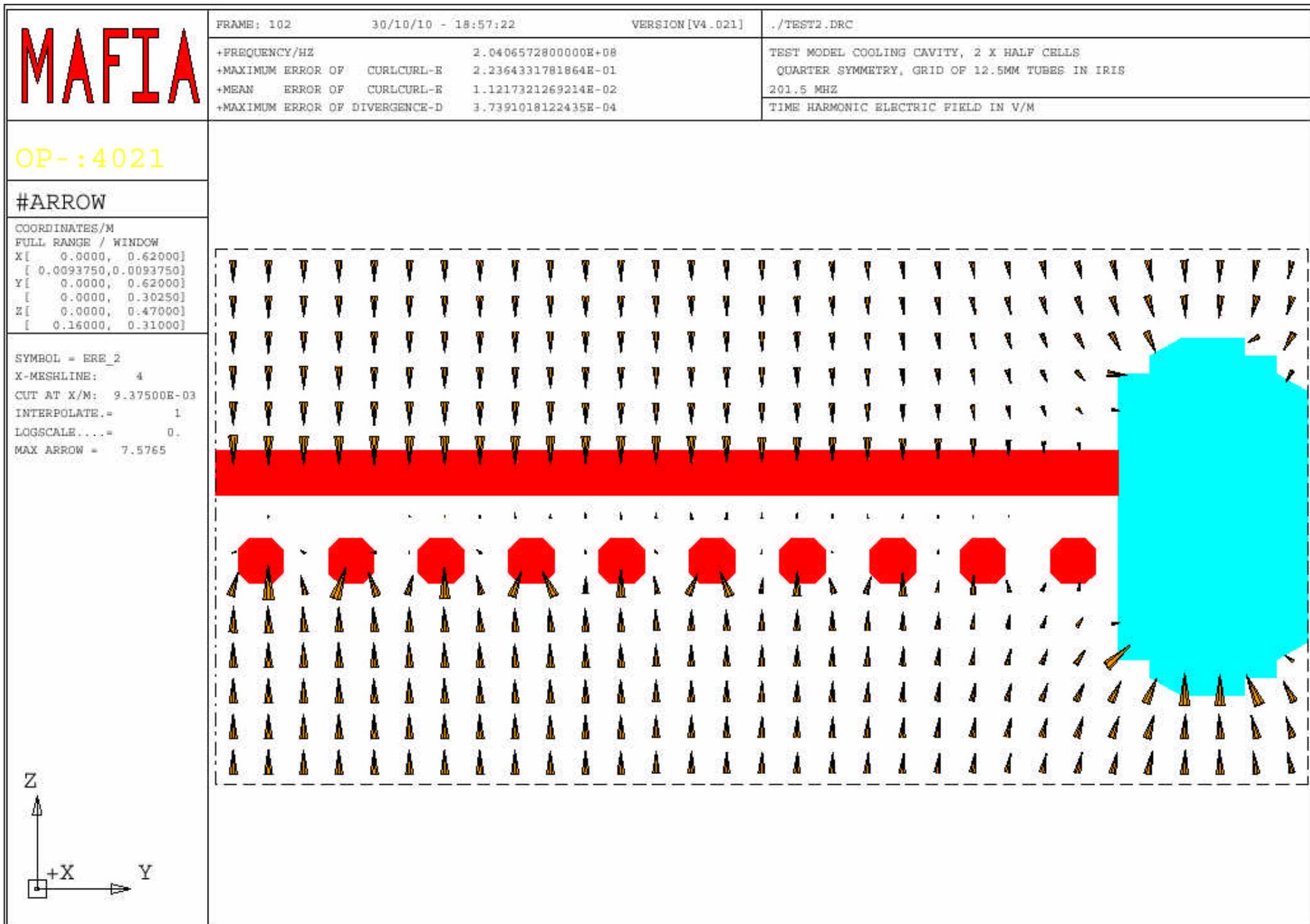
OP-:4021

#ARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
  [0.0093750,0.0093750]
Y[0.0000, 0.62000]
  [0.0000, 0.62000]
Z[0.0000, 0.47000]
  [0.0000, 0.47000]

SYMBOL = ERE_2
X-MESHLINE: 4
CUT AT X/M: 9.37500E-03
INTERPOLATE.=   1
LOGSCALE....=   0.
MAX ARROW =   6.6042

Z

+X   Y

2D view of accelerating mode (E-field, 130° phase advance)

MAFIA

+FREQUENCY/HZ   2.04065728000000E+08
+MAXIMUM ERROR OF   CURLCURL-E   2.23643317818646E-01
+MEAN   ERROR OF   CURLCURL-E   1.12173212692146E-02
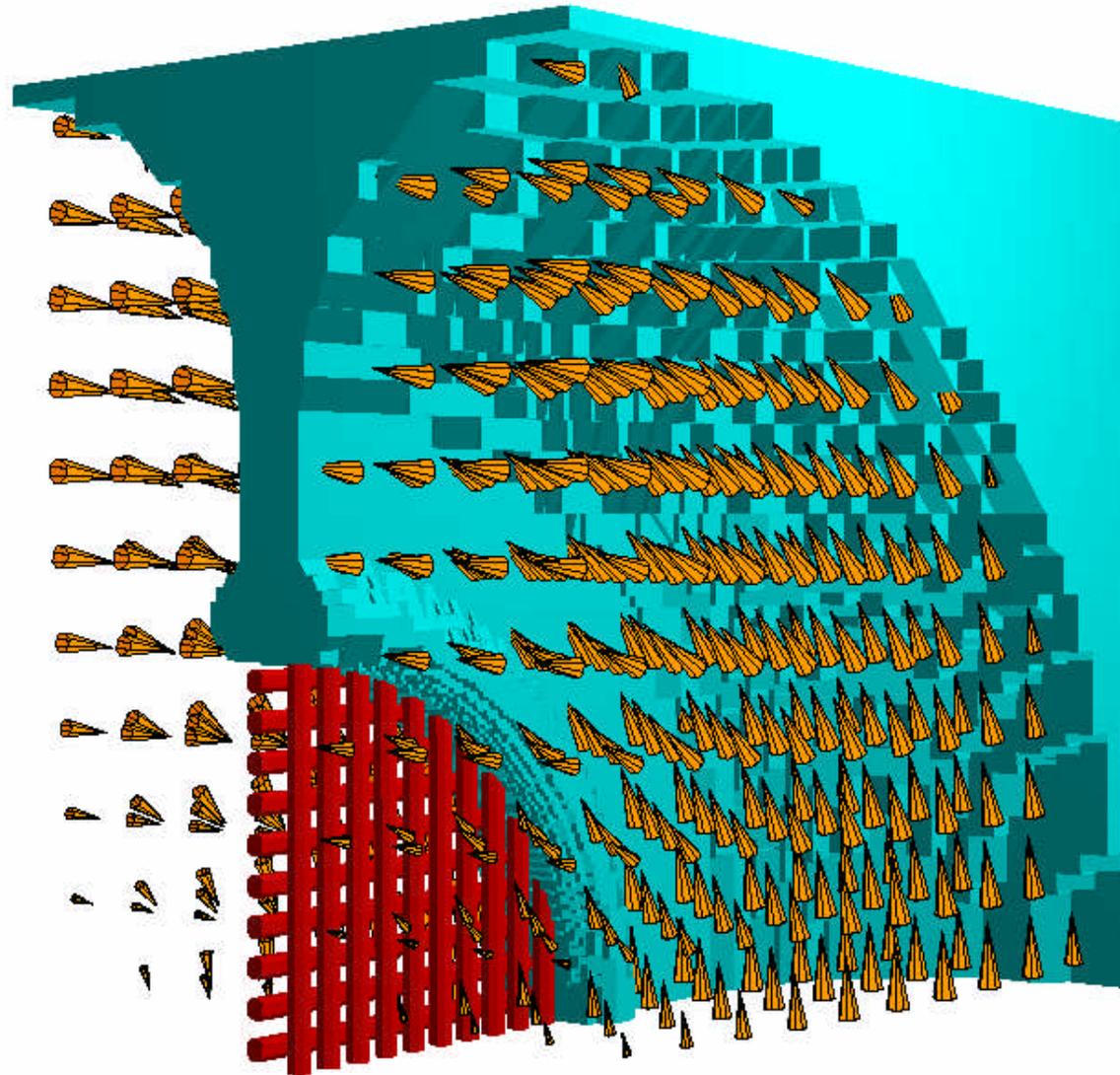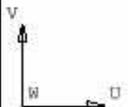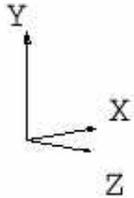+MAXIMUM ERROR OF DIVERGENCE-D   3.73910181224350E-04

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
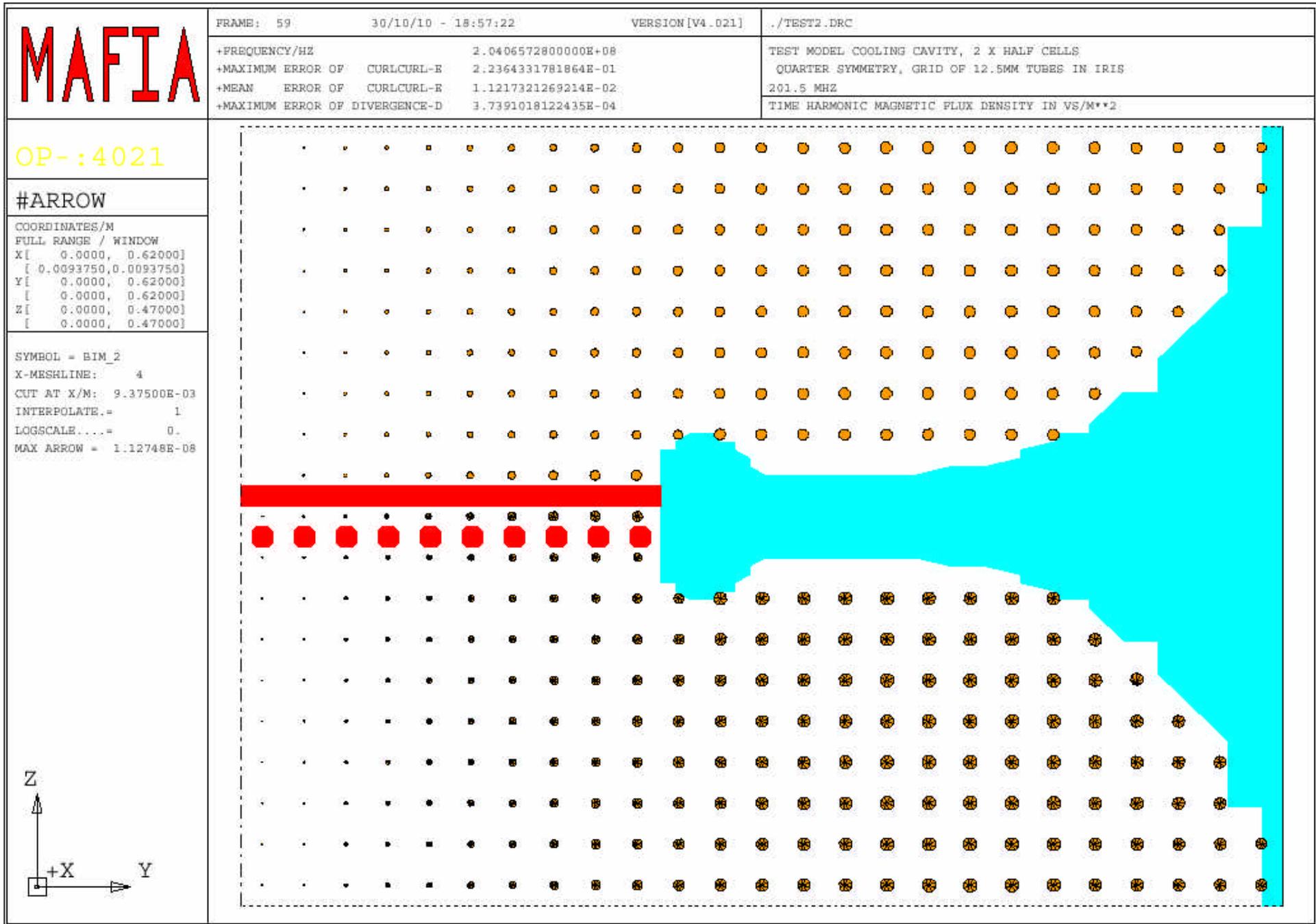TIME HARMONIC ELECTRIC FIELD IN V/M

OP-:4021

#ARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
 [0.0093750,0.0093750]
Y[0.0000, 0.62000]
 [0.0000, 0.30250]
Z[0.0000, 0.47000]
 [0.16000, 0.31000]

SYMBOL = ERE_2
X-MESHLINE: 4
CUT AT X/M: 9.37500E-03
INTERPOLATE.=   1
LOGSCALE....=   0.
MAX ARROW =   7.5765

Z

+X   Y

2D close-up view of accelerating mode (E-field, 130° phase advance)
note: transverse fields around tubes

MAFIA

FRAME: 80	30/10/10 - 18:57:22	VERSION[V4.021]	./TEST2.DRC

+FREQUENCY/HZ	2.04065728000000E+08	TEST MODEL COOLING CAVITY, 2 X HALF CELLS
+MAXIMUM ERROR OF CURLCURL-E	2.2364331781864E-01	QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
+MEAN ERROR OF CURLCURL-E	1.12173212692l4E-02	201.5 MHZ
+MAXIMUM ERROR OF DIVERGENCE-D	3.7391018122435E-04	TIME HARMONIC MAGNETIC FLUX DENSITY IN VS/M**2

OP-:4021

#3DARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000,   0.62000]
 [0.0000,   0.62000]
Y[0.0000,   0.62000]
 [0.0000,   0.62000]
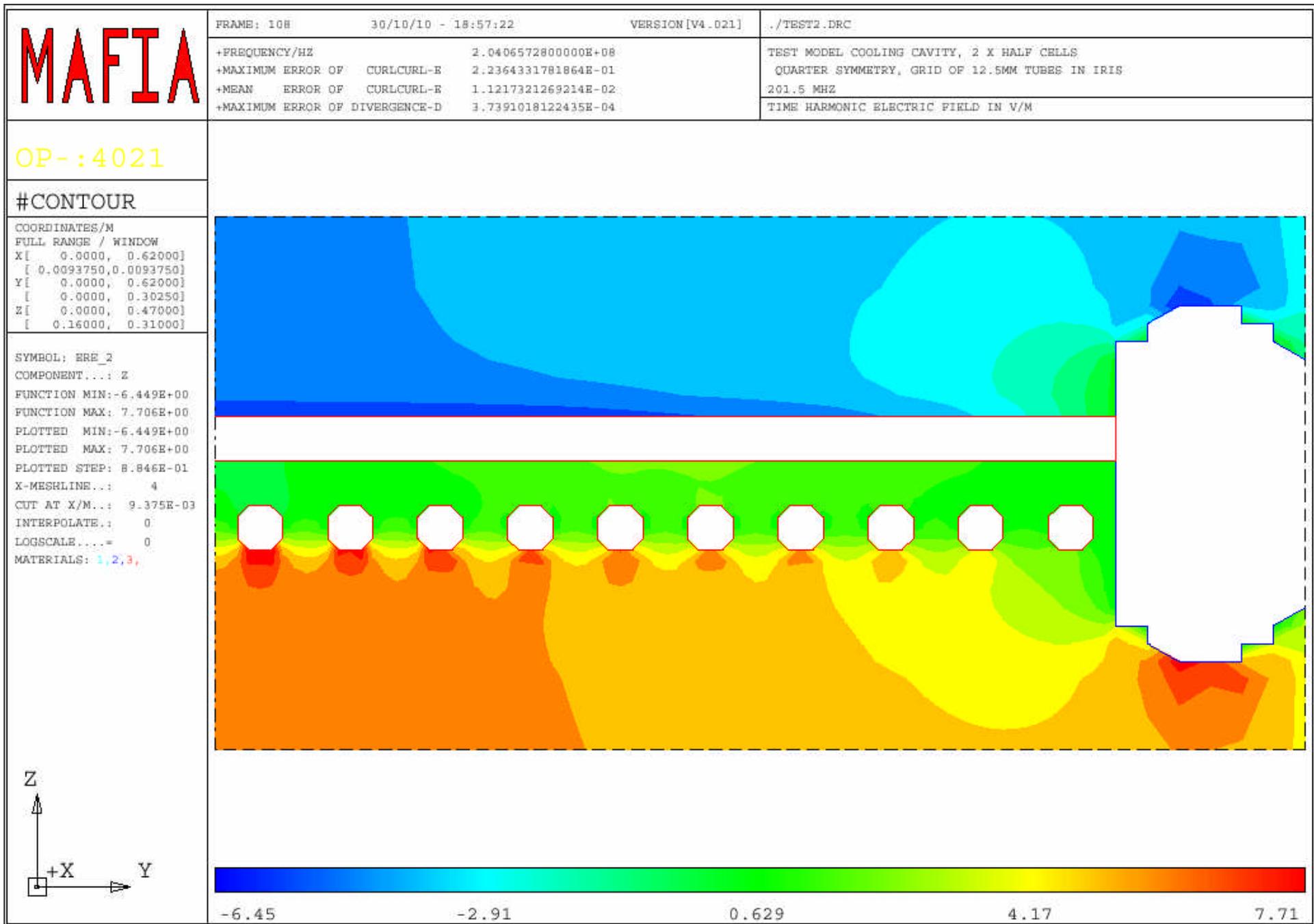Z[0.0000,   0.47000]
 [0.0000,   0.47000]

SYMBOL: BIM_2

TIME......:   2.0000

MAX. ARROW.: 1.158E-08

INTERPOLATE=   1

LOGSCALE...=   0.

MATERIALS: 1,3,

3D view of accelerating mode (B-field, 130° phase advance)

MAFIA

FRAME: 59   30/10/10 - 18:57:22   VERSION[V4.021]   ./TEST2.DRC

+FREQUENCY/HZ   2.04065728000000E+08
+MAXIMUM ERROR OF   CURLCURL-E   2.23643317818864E-01
+MEAN   ERROR OF   CURLCURL-E   1.12173212692214E-02
+MAXIMUM ERROR OF DIVERGENCE-D   3.73910181224352E-04

TEST MODEL COOLING CAVITY, 2 X HALF CELLS
 QUARTER SYMMETRY, GRID OF 12.5MM TUBES IN IRIS
201.5 MHZ
TIME HARMONIC MAGNETIC FLUX DENSITY IN VS/M**2

OP-:4021

#ARROW

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000,   0.62000]
 [0.0093750,0.0093750]
Y[0.0000,   0.62000]
 [0.0000,   0.62000]
Z[0.0000,   0.47000]
 [0.0000,   0.47000]

SYMBOL = BIM_2
X-MESHLINE: 4
CUT AT X/M: 9.37500E-03
INTERPOLATE.=   1
LOGSCALE....=   0.
MAX ARROW = 1.12748E-08

Z

+X   Y

2D view of accelerating mode (B-field, 130° phase advance)
note: B-field between two grids

MAFIA

OP-:4021

#CONTOUR

COORDINATES/M
FULL RANGE / WINDOW
X[0.0000, 0.62000]
  [0.0093750,0.0093750]
Y[0.0000, 0.62000]
  [0.0000, 0.30250]
Z[0.0000, 0.47000]
  [0.16000, 0.31000]

SYMBOL: ERE_2
COMPONENT...: Z
FUNCTION MIN:-6.449E+00
FUNCTION MAX: 7.706E+00
PLOTTED MIN:-6.449E+00
PLOTTED MAX: 7.706E+00
PLOTTED STEP: 8.846E-01
X-MESHLINE..:   4
CUT AT X/M..: 9.375E-03
INTERPOLATE.:   0
LOGSCALE....=   0
MATERIALS: 1,2,3,

Z

+X   Y

-6.45   -2.91   0.629   4.17   7.71

2D contour plot of accelerating mode (Ez-field, 130° phase advance)
note: local field enhancement on tubes and cavity noses
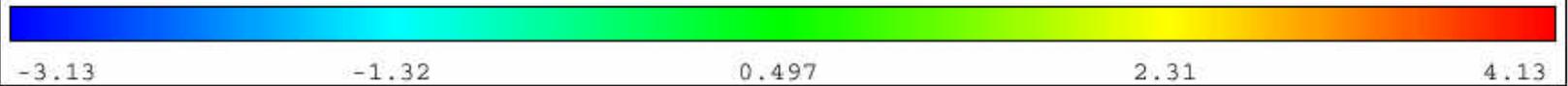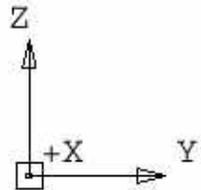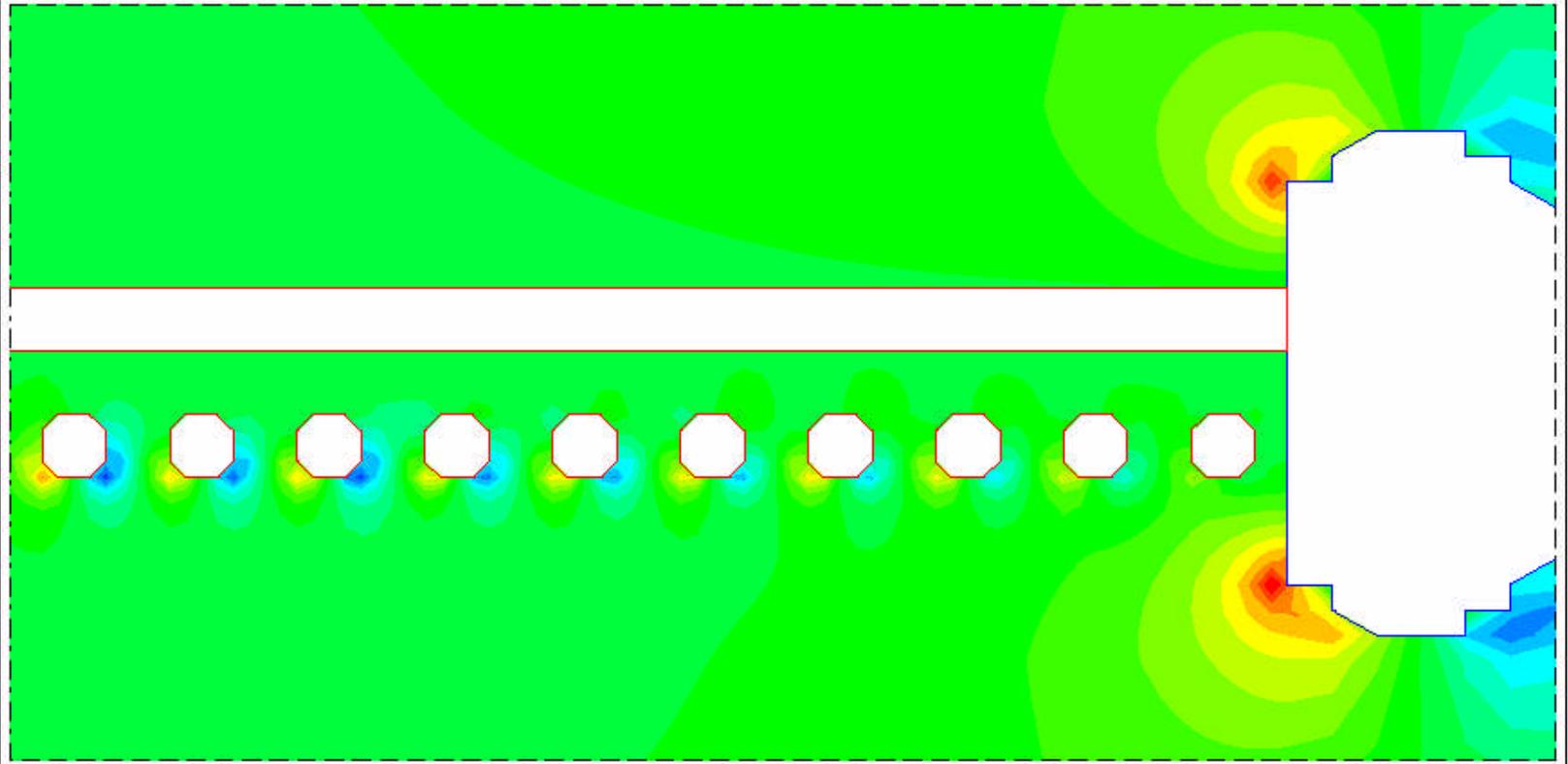
2D contour plot of accelerating mode transverse (Ey) field,
note: local transverse fields on tubes and cavity noses
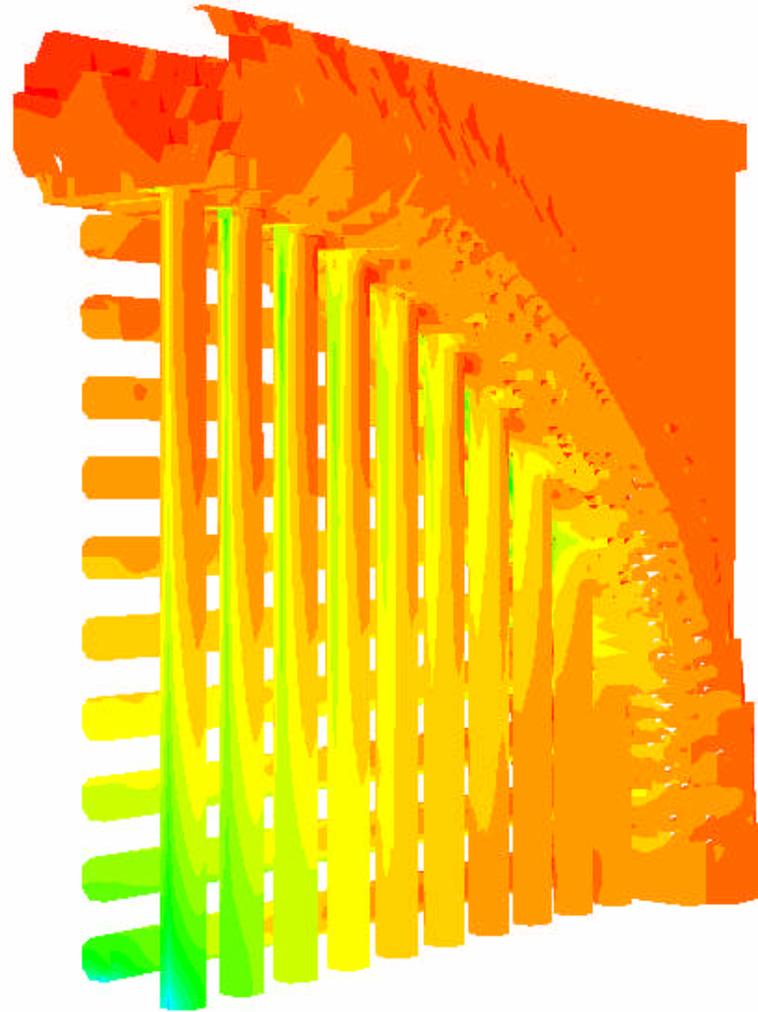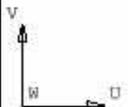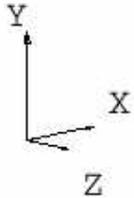
3D contour plot of surface losses on grid (log scale)
note: non-uniform distribution and heating on both sides of tubes